Management of true aneurysms distal to the axillary artery

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Objective: **To delineate management strategies and outcomes for true aneurysms involving arteries of the upper extremity distal to the axillary artery. The management of these rare lesions has not been well established in the literature.**

Methods: **Retrospective chart review was performed at tertiary referral centers. All patients who received the diagnosis of true upper extremity aneurysms distal to the axillary artery between 1975 and 1995 were included in the review. Nineteen patients were found; seven were excluded because no confirmatory diagnostic imaging study or operative exploration was performed. This represents the largest reported series of true upper extremity arterial aneurysms.**

Results: **Twelve patients (9 men or boys) had 12 confirmed true aneurysms of the brachial or more distal arteries. The average diameters were as follows: brachial artery 4.6 cm, radial artery 2.0 cm, ulnar artery 1.4 cm, and digital artery 0.8 cm. The mean age was 51 years (range, 10 to 86 years). The most common presentation was the presence of a mass. This occurred among eight patients (67%). Four patients (33%) reported pain or paresthesia. One patient (8%) had cold intolerance only. Three patients (25%) had thromboembolic complications. Complications did not consistently correlate with size or presence of intramural thrombus. Three aneurysms (25%) were initially managed nonoperatively and followed for a mean period of 71 months. One of these required operative repair after 5 months because of progressive pain. Ten patients (83%) were treated surgically as follows: five underwent ligation and excision only, and five underwent excision and revascularization. Morbidity was minimal, and there were no perioperative deaths.**

Conclusion: **True arterial aneurysms of the upper extremity distal to the axillary artery are rare and most commonly caused by blunt trauma. Fifty-eight percent of these lesions present with symptoms or complications. Thirty-three percent of asymptomatic lesions later become symptomatic. These factors combined with the minimal morbidity associated with repair suggest that operative repair should be routinely performed for these aneurysms. Revascularization can be performed selectively. (J Vasc Surg 1998;28:606-10.)**

Hippocrates in 460 BC was the first to diagnose an upper extremity arterial aneurysm.[1] Though these lesions have long been recognized, Guattani has been credited with the first accurate description of an upper extremity arterial aneurysm in 1772.[2] Upper extremity arterial aneurysms are uncommon lesions, and are most commonly false aneurysms. The natural history of false upper extremity arterial aneurysms has been well established by other authors. Early operative intervention has been recommended as the preferred management.[3,4] More proximal true aneurysms of the chest, including the innominate and subclavian arteries, are most commonly atherosclerotic in origin, and early operative repair has been recommended for these lesions.[5-7] True upper extremity arterial aneurysms of the axillary artery are most commonly caused by atherosclerosis or blunt trauma; operative intervention is recommended for these lesions.[8,9] True aneurysms of the brachial and more distal arteries are rare.[10] The management of these aneurysms has not been well established. Our purpose was to delineate the appropriate management of these aneurysms and determine the role of nonoperative management.

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METHODS

All medical records of patients with the diagnosis of aneurysms of the brachial, radial, ulnar, palmar, or digital arteries from 1975 through 1995 were reviewed. The brachial artery was defined proximally by the lower margin of the tendon of the teres major muscle. Excluded from review were patients with pseudoaneurysms or a history of penetrating trauma. All aneurysms in patients with a history of blunt trauma were confirmed to be true aneurysms at histopathologic examination. Nineteen aneurysms were identified. Of these, 7 were diagnosed by means of physical examination with no confirmatory diagnostic radiologic study or operative exploration. These patients were eliminated from further review. Twelve aneurysms in 12 patients composed the study group. This represents the largest reported series of true upper extremity arterial aneurysms. Retrospective chart review included medical history, clinical presentation, diagnostic tests including measurement of aneurysm diameter, management, and pertinent operative, pathologic, and follow-up findings.

RESULTS

Twelve patients had confirmed true upper extremity arterial aneurysms of the brachial or more distal arteries (Fig 1). Nine (75%) patients were men or boys. The mean age was 51 years with a range of 10 to 86 years. Anatomic classification was as follows: 2 brachial, 2 radial, 5 ulnar, and 3 digital artery aneurysms (Table I). Eight aneurysms (67%) were located in the right upper extremity. The average maximum diameter of the aneurysms for each anatomic location was as follows: brachial 4.6 cm, radial 2.0 cm, ulnar 1.4 cm, and digital 0.8 cm. Eight (67%) of the aneurysms had intramural thrombus present.

The cause of the aneurysms was repetitive blunt trauma in 6 instances and idiopathic factors in 6 instances (Table I). Of the 6 patients with traumatic aneurysms, 3 had occupations that exposed them to repetitive blunt trauma, and 3 participated in recreational activities in which they sustained repetitive blunt trauma. Only 1 patient (8%) was found to have a concurrent aneurysm; this was a popliteal artery aneurysm. Three patients (25%) had a history of smoking and 4 (33%) had hypertension.

Eight patients (67%) had a mass, 4 (33%) of which caused pain or paresthesia. Two patients (17%) had digital ischemia from embolism, and 1 patient (8%) with a brachial artery aneurysm had thrombosis and limb-threatening ischemia. One patient (8%) had cold intolerance only. Of 8 aneurysms investigated with ultrasound, 4 (50%) were diagnosed correctly. The others were interpreted as representing simple cysts. One magnetic resonance imaging examination was performed and did not show the aneurysm. The diagnosis was established for 5 of 6 patients who underwent arteriography. One patient with a thrombosed brachial artery aneurysm was found to have occlusion on the arteriogram, but the aneurysm itself was not identified in that study. This aneurysm and 2 other aneurysms were diagnosed at operative exploration.

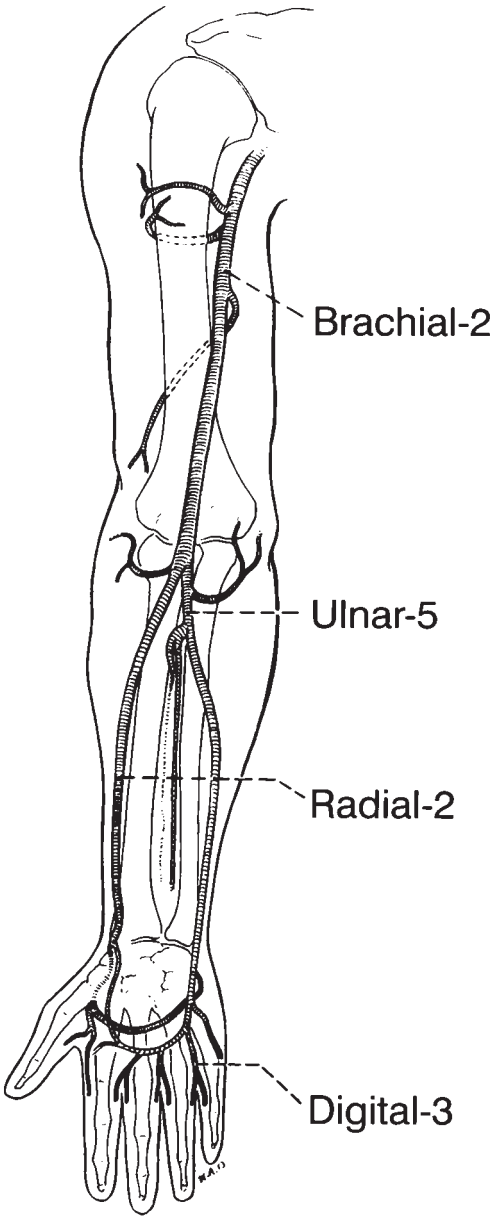

Fig 1. Locations of aneurysms.

The decision to repair or follow each aneurysm

Table I. Summary of aneurysms

Artery	*Size (cm)*	*Presentation*	*Cause*	*Operation*
Brachial	5.3*	Thrombosis	Idiopathic	Excision, revascularization with saphenous vein†
Brachial	3.8*	Symptomatic mass	Repetitive trauma	Excision, revascularization with internal iliac artery
Radial	3.0*	Asymptomatic mass	Repetitive trauma	Ligation and excision
Radial	1.0	Asymptomatic mass	Idiopathic	None
Ulnar	2.1*	Embolization	Repetitive trauma	Excision with primary anastomosis
Ulnar	1.4*	Embolization	Repetitive trauma	Excision with primary anastomosis
Ulnar	1.3	Symptomatic mass	Idiopathic	Ligation and excision‡
Ulnar	1.2	Cold intolerance	Repetitive trauma	Excision, revascularization with a dorsal hand vein
Ulnar	0.8*	Symptomatic mass	Repetitive trauma	Ligation and excision
Digital	1.0	Asymptomatic mass	Idiopathic	Ligation and excision
Digital	0.9*	Asymptomatic mass	Idiopathic	None
Digital	0.4*	Symptomatic mass	Idiopathic	Ligation and excision

*Intramural thrombus present.
†Emergency procedure.
‡Initially managed nonoperatively but eventually repaired because of pain.

was made at the discretion of the surgeon. Factors considered included symptoms, perceived risk for rupture or thromboembolic complications, and operative risk. Three patients (25%) were initially treated nonoperatively with a mean follow-up period of 71 months. Two (67%) of these patients had no complications or symptoms. One patient initially treated nonoperatively needed operative repair of his aneurysm after 5 months because of progressive pain. Of the 10 aneurysms repaired operatively, 5 (50%) were managed with ligation and excision and 5 (50%) with excision and revascularization. The decision to ligate or revascularize the affected artery was made at the discretion of the surgeon. Factors considered included location of the aneurysm, back bleeding, capillary refill after arterial occlusion, and ease of primary repair. Revascularization was performed with two venous conduits, one internal iliac artery conduit, and two primary anastomoses (Table I). The internal iliac artery was chosen for durability because the patient was 10 years of age. There was no perioperative mortality or serious morbidity.

The average length of the follow-up period for all patients was 31 months (range, 0 to 199). The adequacy of perfusion and the patency of grafts and primary repairs were assessed on the basis of patient symptoms and findings at physical examination. All grafts and primary repairs were clinically patent at last follow-up evaluation. No patients had recurrences or ischemic symptoms. All preoperative symptoms resolved except those of the patient with cold intolerance; his symptoms continued after aneurysm repair.

DISCUSSION

The most commonly identified cause of true aneurysms of the upper extremity arteries distal to the axillary artery is repetitive blunt trauma. This historical feature was present among 50% of patients in our review. The remaining aneurysms, however, had no identifiable cause and were classified as idiopathic. These findings are consistent with those in previous reports that blunt trauma is the most common cause of true upper extremity arterial aneurysms and that most of the other lesions are idiopathic.[1,3,4] Repetitive trauma related to occupational or recreational activities has been implicated.[1,3,4,11-13] The mechanism of aneurysm formation is considered to be compression of the arterial wall producing contusion of the arterial media with subsequent weakness of the wall and fusiform dilatation.[3,11] True aneurysms also have been caused by arteriosclerotic, congenital, and metabolic disorders[5,14-18] and can be associated with diseases such as Kawasaki's syndrome,[19] Buerger's disease,[20] Kaposi's sarcoma,[21] and cystic adventitial disease.[22,23]

A high rate of concurrent aneurysms would not be expected among patients with upper extremity arterial aneurysms because most of these aneurysms are caused by local trauma or are idiopathic. In our study only 1 patient (8%) had a concurrent aneurysm. These patients commonly lack risk factors for arteriosclerotic disease. Only 25% of patients in our series had a history of smoking, and 33% had hypertension.

The most common location of aneurysms in this series was the ulnar artery. This has been the most commonly reported site of true arterial aneurysms in the upper extremity.[1,3,4,11] The ulnar artery is at par-

ticular risk at the hypothenar eminence because of its superficial location over the hook of the hamate. Blunt trauma at this location causes compressive injury in which the hamate acts as an anvil.[2,10,24-29] This anatomic relation is responsible for the hypothenar hammer syndrome.[27,30] The radial artery also is at risk at the wrist because of its superficial location over the trapezial ridge.[2,10,31] Fifty-eight percent of the aneurysms in our series were located in the ulnar or radial artery, and all of these were at the wrist level. There were 3 digital artery aneurysms in our review. Only 14 true digital artery aneurysms have been reported in the English literature.[3,32-40]

Patients with true upper extremity arterial aneurysms generally have a mass, but they also may have pain or paresthesia from local nerve compression or distal ischemia from thromboembolic events.[1,11] Arterial aneurysm should always be included in the differential diagnosis when upper extremity embolic events are identified. As many as 20% of upper extremity emboli arise from an arterial, not a cardiac, source.[8] Our series demonstrated that a large percentage (58%) of these patients have symptoms that include potentially limb-threatening ischemia.

The diagnosis of true upper extremity arterial aneurysms distal to the axillary artery is suggested at physical examination. The differential diagnosis includes ganglion or synovial cyst, dermoid cyst, abscess, neural tumors, muscular fibroma, and Raynaud's disease.[1,11] Ultrasonography is generally the first test performed,[1,3,41] but the findings can be misleading. Four of 8 (50%) aneurysms in our series were misinterpreted on ultrasound scans as simple cysts. All studies that were misinterpreted were performed when Doppler technology was available, but only one examination entailed use of Doppler signals. Because these lesions are rare, it is important to include true aneurysm in the differential diagnosis and obtain Doppler signal data. Arteriography was helpful in all 6 patients on whom it was performed. The need for arteriography after the diagnosis has been made has been debated. In general, arteriography provides valuable preoperative anatomic detail for lesions proximal to the upper forearm but can be used more selectively distal to this region. Some authors have reported good results with radionuclide imaging of upper extremity arterial aneurysms.[3,42]

Operative intervention has long been the management of choice for upper extremity arterial aneurysms since the first report by Griffith in 1897.[43] Most experience, however, has been with false aneurysms. The management of true aneurysms often has been extrapolated from reports regarding false aneurysms, but the natural history of true upper extremity arterial aneurysms has not been established. In our series, the aneurysms causing complications tended to be larger and contain intramural thrombus. Most aneurysms with complications were at least 50% larger than other aneurysms affecting the same artery (Table I). In contrast, the aneurysms followed nonoperatively were smaller, and only one contained intramural thrombus. Because the number of aneurysms managed nonoperatively was small, correlation of size or presence of intramural thrombus with risk of complications cannot be determined. Although some of these aneurysms were safely followed nonoperatively, we cannot predict which aneurysms are more likely to produce complications. Thirty-three percent of the asymptomatic lesions that were followed went on to become symptomatic. Because of the high incidence of symptoms and complications and the minimal morbidity associated with repair, routine operative repair should be performed.

The need for revascularization after resection of an aneurysm of the radial or ulnar arteries or arteries of the hand has been debated. Some authors have proposed revascularization whenever possible,[1,17] whereas others have argued for selective revascularization.[3,11,29,44] Our series demonstrated that revascularization can be performed selectively. The 5 patients who did not undergo revascularization at the time of aneurysm resection had no ischemic complications. The decision not to perform revascularization on these patients was based on the artery affected, the adequacy of arterial back bleeding, and findings at intraoperative examination of the extremity after interruption of blood flow through the affected artery. Some authors have shown that the addition of digital plethysmography to clinical examination can provide a quantitative Allen test.[3,11,45] In a series of replanted digits, a digital pulse volume recording of less than 75% of normal was associated with postoperative ischemic symptoms.[46] Revascularization should be routine in treating patients with brachial artery aneurysms, but given the risks of reconstruction, such as pseudoaneurysm, selective revascularization is indicated in the management of true upper extremity arterial aneurysms of the radial, ulnar, or more distal arteries. The decision to revascularize should be based on the presence of back bleeding, clinical findings of perfusion, or results at digital plethysmography.

CONCLUSIONS

True upper extremity arterial aneurysms distal to the axillary artery are rare and are most commonly caused by blunt trauma. Fifty-eight percent of these

lesions present with serious symptoms or complications. It is unclear which asymptomatic aneurysms can be safely managed nonoperatively, and 33% later become symptomatic. These factors combined with the minimal morbidity associated with repair suggest that operative repair should be performed routinely for true upper extremity arterial aneurysms distal to the axillary artery. Revascularization can be performed selectively.

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